

Ambulatory Chemotherapy in Alaska

MERILYS E. PORTER, R.N., M.P.H., and GEORGE W. COMSTOCK, M.D., Dr.P.H.

"TUBERCULOSIS is the Alaskan scourge" was the succinct statement that introduced the Parran Committee's recommendations for emergency action against tuberculosis in Alaska (1). Called together in 1953 to consider what might best be done to improve the health of Alaskans, these public health experts studied the situation in detail and recommended an intensified program of casefinding, hospitalization, and outpatient treatment as the principal means of ending the tuberculosis epidemic.

Eight years later, the objectives of the emergency program resulting from this recommendation appeared to have been achieved. No longer was tuberculosis the prime killer of Alaskan Eskimos, Indians, and Aleuts. Hospital treatment of all patients, a goal which once seemed so remote, was now possible without the use of facilities outside Alaska (2). Even more encouraging was the decreased risk of becoming infected with tubercle bacilli. In 1950, one of every four infants in some areas became infected during the first year of life; a decade later, only 1 infant in 100 became infected each year (3). Although tuberculosis was far from conquered, the results of the emergency program made it possible to hope for eventual victory.

Credit for the dramatic decline in tuberculosis cannot be assigned to any one group nor to any

single control procedure. Almost everyone concerned—patients, their families and neighbors, and workers at all levels in education, health, and welfare activities—played an important and interdependent role. Similarly, all activities of the tuberculosis control program were both important and interdependent.

Even the control program's most unusual feature, the emphasis on chemotherapy for patients living at home in remote areas and often under primitive conditions, could not be dissociated from other activities. In January 1954, because more than 1,500 patients needed hospitalization and only 575 Alaska Native Service beds were available, it appeared that ambulatory chemotherapy might have to serve as a substitute for hospitalization in many instances. However, during the next 2 years, the number of hospital beds was more than doubled, largely through contracts with hospitals in the State of Washington and a private hospital in Seward, Alaska. In addition, a decrease in the length of time patients were hospitalized made the existing beds available to more patients during any given year. The decreased hospital stay appears to have been the result of at least three factors: increased effectiveness of hospital treatment, feasibility of earlier discharge once a program of supervised home care was instituted, and decreased severity of disease at admission among patients who had been on chemotherapy at home.

Because ambulatory chemotherapy in Alaska was an apparently successful pioneering project, and because ambulatory chemotherapy has become a major element in tuberculosis control in many areas, the Alaskan experience may interest those who have similar problems and re-

Miss Porter, formerly a nursing consultant in the Tuberculosis Branch, Public Health Service, is assistant director, Nursing Research Field Center, Public Health Service, San Francisco. Dr. Comstock is chief of epidemiological studies in the Tuberculosis Branch.

sponsibilities in bringing public health to peoples of other cultures. In addition to reviewing the history of the ambulatory chemotherapy program in Alaska, we have also attempted to estimate its effectiveness for patients awaiting hospitalization.

Organizing the Program

Following the recognition of isoniazid as an effective antituberculosis agent in 1952, the feasibility of a home treatment program in Alaska was seriously considered by persons interested in tuberculosis control, including representatives from the Alaska Department of Health, the Arctic Health Research Center of the Public Health Service, and the Alaska Native Service of the Bureau of Indian Affairs. Some home treatment was actually started, mostly by physicians at the Alaska Native Service field hospitals. However, an organized program was begun only after the Parran Committee made its recommendations in 1954.

The ambulatory chemotherapy program served the portion of Alaska lying roughly north and west of the Alaska Railroad, which runs from Seward through Anchorage to Fairbanks. In this area of approximately 400,000 square miles, nearly as large as Texas and California combined, live some 25,000 persons, chiefly Eskimos and Indians. The area was selected because of the high prevalence of tuberculosis in this population and difficulties in providing services in this sparsely settled, roadless land.

The program was initiated in January 1955 in the Bethel Hospital service area. Here, near the mouths of the Yukon and Kuskokwim Rivers, live the greatest concentration of natives in Alaska. This population had the highest tuberculosis rates in Alaska. The program was started in the Barrow area in February, in the Tanana area in April, and in the Kotzebue area in October 1955. By July 1956, 1,625 patients, about 9 percent of the total population in the 70 villages in the program, were receiving chemotherapy at home. The 70 villages are shown on the map.

Medical services, including supervision of tuberculosis treatment, were provided by four field hospitals located in the villages for which

each hospital service area was named. These villages were also local headquarters for almost all other services—public health, education, welfare, business, and transportation. The Tanana area also received some services from Fairbanks. At the start of the program, the field hospitals were staffed by the Alaska Native Service of the Bureau of Indian Affairs. In July 1955, these facilities with their staffs and responsibilities, including financial support of the ambulatory chemotherapy program, were transferred to the Alaska Native Health Service, Division of Indian Health of the Public Health Service. Throughout the chemotherapy program, the public health functions were primarily the responsibility of the Alaska Department of Health, now the Division of Health of the Alaska Department of Health and Welfare. This agency, under contract with the Alaska Native Health Service, cooperated in chest X-ray surveys, performed laboratory examinations for tubercle bacilli, and provided generalized public health nursing service. Responsibility for the design and supervision of the ambulatory chemotherapy program during its demonstration phase was assigned to the Arctic Health Research Center. After field procedures had been standardized and accepted, the chemotherapy program was to be transferred to the Alaska Department of Health as a part of the generalized public health program.

The first staff members, a medical officer and a public health nursing supervisor, were assigned by the Public Health Service to the Anchorage headquarters in October 1954. At the peak of operations in 1956, there were 20 additional employees—8 nurses and 2 X-ray technicians in the field, a clerk in each chemotherapy office, and a laboratory technician and 2 secretaries in the Anchorage office. The laboratory technician was assigned to the Alaska Department of Health to support an augmented casefinding program. One or more chemotherapy nurses were assigned to each of the four hospital service areas. In addition to the chemotherapy nurse in Tanana, one of the Tanana area nurses was stationed in Fort Yukon and another in Fairbanks. The Fort Yukon nurse was given both office space and guidance by the Episcopal Mission Hospital. In Fairbanks, office space was allocated in the



Hospital service areas and villages in the ambulatory chemotherapy program, Alaska

Alaska Department of Health regional office, an arrangement which provided an excellent opportunity for cooperative planning and use of records. In the Barrow area and on St. Lawrence Island in the Kotzebue area, the Alaska Department of Health public health nurse included ambulatory chemotherapy among her other duties.

In all areas, the native population subsists largely by hunting and fishing. Although most natives have moved to villages with schools, stores, and post offices, their economy still

requires considerable seasonal migration. Seasonal fluctuations in food supplies are usual, with occasional periods of marked privation.

The average village consists of about 200 persons living in 30 to 40 households. All are located on the coast or on navigable streams because of the importance of fishing and water transportation. In the relatively "crowded" Bethel area, some villages are only a few miles apart, but elsewhere distances of 40 to 50 miles to the next village are not unusual. At the time the ambulatory chemotherapy program was

first instituted, day-to-day medical care was generally administered by the school teacher, aided by radio consultation with a doctor at the field hospital on days of good radio reception. A very few villages were fortunate enough to have a registered nurse, usually a missionary or the wife of a trader, but most villages knew nursing services only through infrequent visits of the itinerant public health nurse. When medical emergencies occurred, patients could be flown to a field hospital within a few hours if the weather was favorable, but bad weather could delay flights for days.

In planning home treatment for tuberculosis under these conditions, it was clear that only orally administered medications could be used and that the combination of isoniazid and sodium para-aminosalicylic acid (PAS) was the only reasonable choice. The daily dosage of both drugs was based on the age of the patient and was designed to provide approximately 5 mg. of isoniazid and 200 mg. of PAS per kilogram of body weight. Isoniazid was issued in 50 mg. tablets and PAS in 500 mg. tablets. Patients were advised to take approximately one-third of the daily dosage in the morning, at noon, and at night.

At first, because of the tremendous number of active cases known to the department of health and a waiting period for hospitalization of 6 months to 2 years, finding patients who might be considered for ambulatory chemotherapy presented no problem. Rather, the difficulty was to utilize the limited treatment facilities in the most effective way. A hospitalization priority board, composed of leading tuberculosis specialists meeting semiannually, had been created by the Alaska Native Health Service and the Alaska Department of Health to determine the priorities of patients according to the following outline:

Group A. Eligible for hospitalization, in order of priority:

1. Patients constituting a public health hazard, who could not be isolated at home.
2. Patients unable to obtain medical and nursing supervision and who could be expected to benefit from hospitalization.
3. Patients needing medical and surgical care in addition to chemotherapy.

4. Patients not responding to outpatient treatment.

5. Patients to be admitted for diagnostic evaluation.

Group B. Eligible for outpatient treatment only:

1. Patients who could obtain regular medical and nursing supervision.
2. Patients with minimal tuberculosis.
3. Patients with advanced tuberculosis who might be expected to respond well to chemotherapy.

Group C. No treatment needed.

Assistance of the priority board in the ambulatory chemotherapy program was enlisted at a board meeting in October 1954. Home treatment, it was agreed, would not replace hospital treatment and should not interfere with efforts to provide additional hospital facilities. In all villages participating in the ambulatory chemotherapy program, treatment was to be started for all patients classified in groups A or B. Furthermore, since the priority board met infrequently, arrangements were made for a smaller medical board to assign patients to home treatment before their situation had been reviewed by the priority board. Early initiation of chemotherapy, it was hoped, would prevent progression of disease and diminish infectiousness. Treatment recommendations of both boards were transmitted to physicians in charge of field hospitals who could alter them to fit particular situations. Almost always, however, the boards' recommendations were approved and transmitted to the chemotherapy nurses.

The chemotherapy nurses were responsible for initiating the program in the villages and for seeing that the tuberculosis program operated as smoothly as possible. In planning the program, it was recognized that both ambulatory chemotherapy and the broader field of tuberculosis control were integral parts of the general public health program and that the separation of the functions was only a temporary expedient. To provide continuity of service to patients and to insure that public health nurses and chemotherapy nurses would be informed of each other's plans and activities, the same patient records and family folders were used as much as possible.

Selection of the staff for the chemotherapy program was necessarily limited by availability of personnel, although recruitment was helped considerably by the volunteering of nurses already employed at the field hospitals. All nurses accepted for the program had had some public health or visiting nurse experience. As might be expected, those who liked the Eskimos and Indians and knew something of their customs were most effective in their work.

In the orientation of the nurses, the emphasis placed on public health philosophy, tuberculosis chemotherapy, and Alaskan cultures varied according to the background of each nurse. Special attention was always given to methods of working with individuals and small groups in a way which would lead to appropriate changes in behavior. Further familiarity with field problems and customs was encouraged through conferences between nurses and all agencies working in the assigned area.

The Program in the Villages

The first village visit was planned with assistance from the nursing supervisor, who accompanied the new nurses or arranged for one of the experienced nurses to do so. It was particularly important to keep in mind the limited facilities of these small villages and to be considerate of the school teacher, storekeeper, missionary, or village family who not only provided space for meetings and storage but board and room for visitors as well.

Another important consideration was that the chemotherapy nurses were expected to provide a wide variety of necessary services. Before visiting a village they conferred with the field hospital physician, the public health nurse, the welfare agencies, and others so that current information about hospitalized patients might be transmitted to their families, and known medical or social problems in the village might be investigated. In these villages, which were in varied stages of acculturation, "social" included a broader area than the usual welfare problems. Assistance in moral and legal as well as economic situations as they affected village life was provided by several agencies. Upon arrival in a village, the nurse was often first requested to attend to medical emergencies

so that seriously ill patients might be taken to the hospital by the returning plane. With such urgent matters out of the way, attention could then be given to the ambulatory chemotherapy program.

A fairly standard procedure was evolved for introducing the program to a village. Approval and understanding of the village leaders, usually organized as a village council, had to be obtained if any action in the village was to be effective. There were often other leaders in the village, perhaps holding no formal position, whose cooperation could also be most helpful. During repeated visits to the homes and villages, the nurses observed the treatment program under different conditions and learned realistic procedures for the application of ambulatory chemotherapy to these people of another culture.

That all villages accepted the invitation to participate in the program is a tribute both to the villagers' desire to eliminate the threat of tuberculosis and the nurses' ability to explain the program and win the people's confidence. Furthermore, the villagers gave substance to their cooperation by selecting an unpaid volunteer to act as a "chemotherapy aide." Although village school teachers often gave considerable assistance, particularly in the early years of the program, the aides were the permanent representatives of the program in the villages and played an essential role in its conduct. In most instances, aides were young adult women. Women were more often available because men were frequently absent from the village for long periods on hunting or fishing trips. Although young adults were more likely to possess the degree of literacy required for recordkeeping, it was important that older villagers, especially the council members, approve their selection. In the later years of the program, it was found that patients who had had hospital treatment for tuberculosis made effective chemotherapy aides (4).

The aide saw all patients in the village at intervals of about 2 weeks. At these times, the patients were weighed, given a new supply of medication, and offered an opportunity to discuss any special problems which might have arisen. Simple records were kept of weights, complaints including those possibly connected

with drug reactions, degree of physical activity, and the amount of medication dispensed. In addition, the patients were taught to collect and ship sputum specimens.

Following the initial visit, the nurses in many instances returned in a month to be sure that chemotherapy aides and patients had fully understood the medical instructions. Subsequent visits were scheduled at 3-month intervals. On each visit, the nurses gave classes and demonstrations for patients and their families; the aides also attended these sessions. The aides accompanied the nurses on home visits and by acting as interpreters became familiar with the instructions given the patients.

Periodic encouragement was essential if patients were to continue regular medication. Patients tended to forget the thrice-daily pill-taking, especially as they began to feel better. Recommendations for isolation and rest often had to be applied somewhat elastically when there was only one room and one bed for an entire family or when day-to-day existence required strenuous exertion from both men and women. Fortunately, it appears that chemotherapy can be effective in spite of a considerable degree of physical activity (5-7).

Keeping in mind the need for return visits at about 3-month intervals, each nurse added new villages to the program when she felt that those she had already initiated were progressing satisfactorily. Although it was well recognized that the tuberculosis situation called for speedy application of the program throughout the area, each nurse was urged to be certain a thorough job was done. When more than one nurse was assigned to a service area, each had responsibility for a contiguous subarea. These limited areas required less travel because a nurse could visit more than one village on a trip. It was also easier to keep track of villagers who moved, since moving to neighboring villages was more likely than emigration from the area.

It was found that 10 to 12 villages were the most that one nurse could expect to visit every 3 months. This allowed for visits lasting 3 to 5 days in each village, travel delays, and office time. In addition to time-consuming preparatory arrangements, which had to be made without telephones, collecting and packing equip-

ment for the village visit took a great deal of time and effort. Along with bottles of medications, tuberculin testing equipment, and other nursing supplies, each nurse carried a sleeping bag, emergency food, and extra clothing for a possible forced landing and overnight stay on the tundra. The sleeping bag was also needed for warmth when traveling by dogsled, as well as for sleeping in buildings with limited accommodations.

The provision of facilities for finding new cases and for gauging the progress of known cases presented additional problems, especially since there had been no regularly scheduled casefinding or diagnostic activities before in the ambulatory chemotherapy program area. Repeated chest X-ray surveys seemed to afford the most appropriate solution, even though there were many technical problems. X-ray units had to be compact, lightweight, resistant to low temperatures, and sturdy enough to withstand rough handling. Portable darkroom equipment for loading cassettes, and a gasoline generator also had to be carried. The entire load had to fit into a light plane.

The village councils were most helpful in suggesting suitable dates for scheduling X-ray surveys so as not to conflict with hunting, trapping, or fishing activities. Proper preparation usually resulted in almost complete participation in the surveys. Whenever possible, the nurse was present during the surveys, for although most villagers willingly came to be X-rayed, some, particularly the older people, needed special encouragement. As in other societies, the older members often considered themselves "too old to matter," but they were likely sources of infection to children and grandchildren in the crowded homes.

Examination of sputum specimens for tubercle bacilli was another important diagnostic and screening procedure. Specimens were collected when recommended by the physician who interpreted the X-ray films and also when symptoms suggesting tuberculosis were reported to the nurses or aides. The specimens were mailed to the regional laboratory of the Alaska Department of Health in Anchorage. They arrived 2 to 3 weeks later, usually having been carried by dog team, boat, or bush plane before the final flight to Anchorage. Freezing

and thawing did not seem to harm the specimens, but leakage in transit was a serious problem. Much time was spent in giving instructions aimed at preventing leakage; by contrast, obtaining an adequate specimen was relatively simple.

Gradually, the increasing tempo of tuberculosis control activities began to take effect. Ambulatory chemotherapy became widely accepted as a practicable adjunct to hospitalization. The number of patients needing hospitalization began to decline while the available hospital beds continued to increase, the supply finally meeting the demand during 1956. As a consequence, chemotherapy before hospitalization diminished in importance, while chemotherapy as a continuation of hospital treatment became the major function of the ambulatory chemotherapy program.

In September 1956, less than 2 years after its initiation, the program was taken over as planned by the Alaska Department of Health as an integral part of its public health nursing program in all areas except the Bethel area. There, because of its research interests, the Arctic Health Research Center continues to maintain a small staff of nurses who retain responsibility for ambulatory chemotherapy supervision in addition to their epidemiologic studies.

Evaluation of Prehospital Treatment

Because of objections to a controlled trial of ambulatory chemotherapy, the effectiveness of chemotherapy given prior to hospitalization could not be accurately measured. However, tuberculosis clinicians were convinced at the time that prehospital treatment not only prevented progression of disease during the waiting period but also resulted in improvement for many patients by the time they reached the hospital. Because of widespread interest in outpatient treatment, it was decided in 1961 to attempt an objective evaluation of ambulatory chemotherapy among patients awaiting hospitalization, despite difficulties in the lack of controls and the length of time which had elapsed since the program began.

Although it was obvious that patients treated in the ambulatory chemotherapy program

Table 1. Demographic characteristics of treated and untreated patients, ambulatory chemotherapy program, Alaska

Characteristics	Treated		Untreated	
	Number	Percent	Number	Percent
Total patients-----	285	100.0	114	100.0
<i>Race</i>				
Eskimo-----	246	86.3	101	88.6
Indian-----	39	13.7	13	11.4
<i>Sex</i>				
Male-----	126	44.2	67	58.8
Female-----	159	55.8	47	41.2
<i>Age</i>				
0-14 years-----	63	22.1	25	21.9
15-44 years-----	162	56.8	66	57.9
45 years and older-----	60	21.1	23	20.2
<i>Hospital service area</i>				
Barrow-----	47	16.5	18	15.8
Bethel-----	165	57.9	48	42.1
Kotzebue-----	38	13.3	37	32.5
Tanana-----	35	12.3	11	9.6

might differ in many ways from those who were not treated, it was felt that a reasonable comparison might be made of treated and untreated patients whose hospitalization had been recommended by the priority board. These patients did not include many considered to be clinical emergencies who were hospitalized directly by the field medical officers, nor did they include those with slight or dubious disease for whom the priority board either recommended home treatment alone or no treatment at all. In a sense, group A patients whose hospitalization was recommended by the priority board represent a "middle band" of the spectrum of tuberculous disease. Between October 1954 and July 1956, the dates of the first and last priority board meetings during the demonstration phase, the board recommended hospitalization for 403 patients living in the 70 villages that were included in the ambulatory chemotherapy program. However, 4 patients had already been admitted to the hospital before the date of recommendation, leaving a total of 399 in the study group.

As shown in table 1, the study population can be divided into two groups, treated and un-

treated. Ambulatory chemotherapy was available to 285 persons during the study period; they are classified as treated. There were 114 others for whom treatment was not available during the same period and who are therefore classified as untreated. As far as can be determined, none of the untreated group received chemotherapy prior to hospitalization. Both the treated and untreated patients were residents of the 70 villages included in the program, and both were classified as group A by the priority board. Those who lived in villages where the ambulatory chemotherapy program was initiated before they were hospitalized are classified as treated regardless of how regularly they took the prescribed medication. Untreated patients are those whose group A classification was terminated by hospitalization or death or had persisted for more than 1 year before the initiation of the chemotherapy program in their village. The untreated were more likely than the treated patients to have been classified as group A during the early portion of the study period, to have come from smaller villages, and to have lived in areas with less known tuberculosis.

The treated and untreated groups are similar in racial composition, nearly 90 percent of each being Eskimo. The treated group contained a lower proportion of males than the untreated group because in most areas some of the males, even those with active tuberculosis, were likely to be out on hunting trips when the program was started in their villages. Although many were enrolled in the program at the next visit of the chemotherapy nurse, others were not and were admitted to a hospital before they could be enrolled. The age composition of the groups was similar, with slightly more than half of each group between the ages of 15 and 45. Differences in geographic origin between the groups were related to the timing of the program. Residents of the Bethel area, where the program was first started, comprised a larger proportion of the treated group than of the untreated group.

A comparison of the two groups with respect to their tuberculosis status is shown in table 2. As mentioned earlier, the study population was a medium-risk group, having all been classified as group A by the priority board. Within

group A, the priority classification is difficult to interpret in terms of individual prognosis. There are obvious differences between treated and untreated patients because of the organization of the program. For instance, since nursing supervision was available to patients in chemotherapy villages, the only treated patients who could be classified as group A2, patients without medical or nursing supervision, were those who moved to villages not yet started on the program. The other comparisons in table 2 have a closer bearing on the severity of tuberculosis in the two groups. Among those whose

Table 2. Characteristics of tuberculosis among treated and untreated patients, ambulatory chemotherapy program, Alaska

Characteristics	Treated		Untreated	
	Number	Percent	Number	Percent
<i>Priority board classification</i>				
Total.....	285	100.0	114	100.0
A1 Public health hazard.....	66	23.2	22	19.3
A2 No medical or nursing supervision..	24	8.4	32	28.1
A3 Need additional treatment.....	121	42.5	27	23.7
A4 Poor response to outpatient treatment.....	20	7.0	1	.9
A5 Diagnostic evaluation.....	53	18.6	30	26.3
Group A, class not stated.....	1	.4	2	1.8
<i>Initial stage of disease</i>				
Total with initial films...	198	100.0	69	100.0
Advanced.....	93	47.0	35	50.8
Minimal and suspected. Primary and pleural effusion.....	72	36.4	23	33.3
Negative chest.....	23	11.6	8	11.5
	10	5.0	3	4.4
<i>Initial sputum status</i>				
Total with initial specimens.....	196	100.0	60	100.0
Positive.....	79	40.3	21	35.0
Negative.....	117	59.7	39	65.0
<i>Final hospitalization status</i>				
Total.....	285	100.0	114	100.0
Hospitalized in 1 year..	264	92.6	104	91.2
Not hospitalized in 1 year.....	21	7.4	10	8.8

¹ Includes 1 death from tuberculosis.

² Includes 3 deaths from nontuberculous causes.

initial chest X-rays are still available, the proportions of the X-rays showing the various stages of disease are similar for the two groups. Results of sputum examinations done at the time of priority board classification were also similar for the two groups. In addition, almost the same proportion of each group was actually admitted to a tuberculosis hospital within 1 year.

On balance, although there were known differences between the treated and the untreated groups, it is difficult to see how they could have resulted in appreciably different outcomes of disease, nor can we think of any other characteristics of the two groups which could reasonably be expected to have such results.

Evaluation of the progress of the patients' disease in the period following the recommendation for hospitalization by the priority board was based on roentgenographic and bacteriological changes between two examinations. The "initial" chest X-ray examination for each patient in the study group was defined as the most recent chest X-ray preceding the date of the priority board meeting, between October 1954 and July 1956, at which the first recommendation for hospitalization was made. If no X-ray had been taken within 1 year prior to the date of the meeting, the patient was classified as having no initial chest X-ray examination. For those hospitalized less than 1 year after the priority board's recommendation, the "final" chest X-ray examination was defined as that made within 28 days after hospital admission. For patients not hospitalized within 1 year, the "final" chest X-ray examination was defined as that made on a date nearest to 1 year after the board's recommendation but not exceeding 15 months later. "Initial" and "final" sputum examinations were similarly defined.

Initial and final films could not be obtained for all 399 patients. For 89 patients, only one of the two films was still available in 1961, and only for 246, or 62 percent, were both films available and satisfactory for comparison. Requests for X-rays were sent to the Alaska Department of Health and Welfare and to all hospitals to which Alaskan patients were admitted. The multiplicity of agencies and hospitals involved in the care of Alaskan patients, requiring the shifting of records and X-rays both

within and outside Alaska, may explain why some were not available. Also, many patients were in three or four institutions during their period of hospitalization. Since all study films could not be found, the known characteristics of patients with and without a pair of available films were carefully compared. No significant differences could be detected, and it appeared reasonable to assess the degree of X-ray change between initial and final films of the study group on the basis of the films available.

The X-ray films were read by Comstock and the classification of disease in table 2 is based on his reading of the initial films with no information about the patients except that they were members of the study population. Determination of "initial" and "final" status of disease was done in the following manner to avoid possible observer bias. All identifying markings on the films were completely covered with tape. For half of the patients, those born in an even year, the initial film was labeled A and the final film B; for the remaining half the labeling was reversed. The X-ray reader was given the films in such a way that he could not ascertain which was the true initial film. The A film was always interpreted as if it were the initial film and the B film as the final film.

The results of the film comparisons are shown in table 3. The average interval between initial and final films was 8.8 months. In the treated group, 56 percent showed some degree of X-ray improvement while 13 percent showed worsening of disease. Among the untreated, 35 percent improved and 24 percent became worse.

Pairs of bacteriological examinations of sputum were recorded for 256 patients, or 64 percent of the total study group. Again a careful analysis of subjects with and without complete sputum examinations failed to reveal any significant demonstrable differences. The average interval between initial and final examinations was 5.2 months. As shown in table 4, 79 treated patients had positive sputum initially, of whom 61 percent converted to negative by the final examination. A slightly smaller proportion of the 21 untreated patients with initially positive sputum also converted. Of the 117 treated patients with negative sputum initially, only 3 percent had become positive by the final examination. In contrast, 26 percent of the 39 un-

treated patients with initially negative sputum had positive findings on the final examination. The results for both roentgenographic and bacteriological comparisons were essentially unchanged by adjustments for known differences between the treated and untreated groups.

Discussion

This study confirms earlier clinical impressions that patients who had received ambulatory chemotherapy arrived at the hospital in better condition than those who had not been treated at home. Although it is not certain that the improvement was the result of ambulatory chemotherapy, careful examination of the known attributes of treated and untreated subjects in the program reveals nothing else likely to result in the observed differences in the experience of the two groups. If anything, the known selective factors suggest a poorer prognosis among the treated group.

The benefits of ambulatory chemotherapy were manifested both therapeutically and prophylactically. An appreciably higher proportion of the treated than the untreated showed X-ray improvement, and a smaller proportion of treated patients became worse. This prophylactic effect was more striking with respect to change in bacteriological status. While conversion from positive to negative sputum occurred at about the same rate in both groups, the proportion of persons developing positive sputum was much less among treated than untreated patients.

Improvement on ambulatory chemotherapy was more marked among females than among males, perhaps because women were seen by the nurse earlier since they often stayed in the village while the men were away. Furthermore,

Table 4. Changes in bacteriological status for 256 patients with comparison examinations, by treatment status, ambulatory chemotherapy program, Alaska

Treatment status	Patients with—					
	Positive bacteriology initially			Negative bacteriology initially		
	Total	Negative bacteriology finally		Total	Positive bacteriology finally	
		Number	Percent		Number	Percent
Treated.....	79	48	60.8	117	4	3.4
Untreated....	21	12	57.1	39	10	25.6

taking medication regularly was easier at home than on trips for fishing, trapping, or hunting. It is also possible that women nurses and chemotherapy aides could communicate better with women patients or that in these cultures men found it somewhat difficult to accept advice from women.

However, many patients improved even without treatment and under unfavorable home conditions. This must indicate appreciable resistance against tuberculosis among Alaskan natives, a conclusion in keeping with the clinical impression that exudative tuberculosis is unusually uncommon among them.

While some conditions in the homes of natives were unfavorable for recovery, compensating features favored the program of home treatment. Eskimos and Athabaskan Indians, who comprised this population, are friendly, cooperative people who, having seen many among

Table 3. Changes in X-ray status for 246 patients with comparison films, by treatment status, ambulatory chemotherapy program, Alaska

Treatment status	Total patients		Patients with X-ray status—					
			Improved		Unchanged		Worsened	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Treated.....	184	100.0	103	56.0	57	31.0	24	13.0
Untreated....	62	100.0	22	35.5	25	40.3	15	24.2

them die from tuberculosis, were highly motivated to do what they could to remove this threat.

The influence of a patient discharged from a hospital was a potent factor in the success of the program. Because he was living proof of the efficacy of treatment, he was best qualified to assist the nurses in "spreading the gospel." When increased hospital facilities made it possible to admit patients other than those who were desperately ill and when chemotherapy increased their chances for recovery, the return of hospitalized patients to their homes in increasing numbers resulted in a tremendous boost in morale. Tuberculosis no longer seemed hopeless, dooming one to death or impaired health in a culture where physical strength and vigor were necessary for survival. The fact that chemotherapy greatly reduced the period of bed rest demonstrated the worth of the drugs to the Eskimo and Indian better than any explanation of the drugs' effect on the tubercle bacillus. In general, most patients willingly accepted recommended treatment, either in the hospital or at home, even after the symptoms had disappeared and they felt well. That patients continued to take medication following hospital discharge gave added motivation to those whose tuberculosis treatment was just starting. The emphasis on family and community responsibility for the ambulatory chemotherapy program undoubtedly encouraged individual participation.

Although tuberculosis among Alaskan natives has receded from its almost overwhelming prevalence of a decade ago, it is still a major health problem. How long it remains a major problem will depend very largely on whether tuberculosis control measures can be supported at a level sufficient to allow younger children, now largely uninfected, to remain uninfected throughout life. Even though there are now more than enough hospital beds for tuberculosis patients, ambulatory chemotherapy should be started as soon as the diagnosis of active tuberculosis is made to minimize the period of infectiousness, and treatment must be continued following hospital discharge to diminish the likelihood of relapse. Successful maintenance of this program will require prolonged and imaginative efforts by communities and public

health workers alike without the earlier stimulus of an emergency situation.

Alaskans can take heart from a new tool, the chemoprophylaxis of household associates, which has been demonstrated to be useful during the year following recognition of a source case (8). Furnishing isoniazid to all household associates at the same time a patient is started on chemotherapy and encouraging both family and patient to take medication regularly should be natural steps for the community organization already set up for ambulatory chemotherapy.

The effectiveness of isoniazid in therapy and prophylaxis must not be allowed to obscure other fundamental features of tuberculosis control, however. As long as there are sizable numbers of infected persons, tuberculosis will continue to develop sporadically among them. Procedures for early detection of cases, isolation of infectious cases, and general measures such as improvement of health habits and alleviation of overcrowding, all appear fundamental for holding risk of infection at a minimum. Although chemotherapy can help reduce the danger of infection, it obviously cannot replace these other measures.

Finally, we should keep in mind that effective ambulatory chemotherapy and chemoprophylaxis programs require that patients and families have an initial understanding of the purpose of treatment and continued encouragement to maintain their interest and cooperation. Without the considerable proportion of nursing time devoted to personal and community health education, the ambulatory chemotherapy program could hardly have succeeded. As the tuberculosis problem recedes, the community approach will become less appropriate and greater emphasis will have to be placed on education of individuals and families. Without the background information provided through a group approach, each new patient and family will require even more time and attention from nurses and chemotherapy aides than they do now. Individual motivation, rather than medication, appears to be the critical element for future tuberculosis control.

Summary

Late in 1954, while the tuberculosis problem in Alaska was still extremely serious and large

numbers of patients were awaiting hospitalization, home treatment with isoniazid and sodium para-aminosalicylic acid was initiated as a demonstration project. Two years later, ambulatory chemotherapy was accepted as an important part of generalized public health activities. Noteworthy in the success of the treatment program was the cooperation among governmental health agencies, the assistance given by village teachers, the dedicated efforts of the field nurses, and the fine participation of the villagers themselves. Every village accepted the invitation to participate in the ambulatory chemotherapy program. By July 1956, 1,625 patients, about 9 percent of the total population in the 70 villages in the program, were receiving chemotherapy at home.

In 1961 an evaluation of the effectiveness of chemotherapy given prior to hospitalization was undertaken. The evaluation was based on a study of 399 Eskimo and Indian patients recommended for hospitalization by a priority board between October 1954 and July 1956. Of the group, 285 were classified as treated under the chemotherapy program, and 114 were classified as untreated.

Chest X-ray films of treated patients showed 56 percent became better and 13 percent worse while awaiting hospitalization. Among untreated patients, 35 percent improved and 24 percent became worse. Bacteriological examinations showed 60 percent of both treated and untreated patients with initially positive sputum converted to negative. Among those with negative sputum initially, only 3 percent of the treated patients became positive, contrasted with 26 percent of untreated patients.

These findings indicate the usefulness of ambulatory chemotherapy among persons awaiting hospitalization for tuberculosis. However, chemotherapy should not obscure the importance of other measures to prevent tuberculous infection, nor should it be forgotten that the success of ambulatory chemotherapy depends as much on motivation as on medication.

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Funds for Sewage Treatment Plants

Ninety million dollars has been allocated by the Public Health Service to help communities build sewage treatment plants during fiscal year 1963. Appropriations of \$80 million for fiscal year 1962 helped communities provide 754 similar facilities.

Of 3,500 projects approved since 1956, 2,078 have been completed. The approved projects have received \$300 million in Federal funds to support construction costing nearly \$1.4 billion. They have helped abate pollution in approximately 38,000 miles of streams serving more than 35 million people.